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The Utilization of Proteins and Amino Acids

SUMMARY

Depletion and Repletion Experiments in Dogs

The nitrogen balance indexes of lipid extracted whole egg were determined in normal, protein depleted, and protein repleted dogs (see Table I). The dogs were depleted by feeding a protein-free diet until the plasma albumin/globulin ratio was approximately 0.5 (determined by salt fractionation). Previous experience had demonstrated that this ratio represented severe depletion. The average plasma protein concentration in these depleted dogs was 4.7 grams per cent. The dogs were repleted by feeding 0.32 grams of whole egg nitrogen/day/kg. of body weight for 30 days.

Table I

Nitrogen balance indexes of whole egg protein (Viobin) before and after depletion in proteins and after repletion on whole egg for thirty days. UNo before and after depletion in proteins and after repletion with whole egg.

Dog #	Nitrogen Balance Index			Protein-free urinary Nitrogen excretion (UNo)		
	Control	Depleted	Repleted	Control gm/day/ sq.M.	Depleted gm/day/ sq.M.	Repleted gm/day/ sq.M.
28	--	1.06	0.96	--	0.87	1.04
42	0.84	0.95	1.05	1.72	0.80	1.50
44	0.89	1.11	0.89	2.29	0.99	1.04
63	0.91	1.09	0.96	1.85	0.88	1.17
73	0.89	1.13	--	2.67	0.85	--
74	[illegible]	[illegible]	0.81	3.23	0.97	1.29

The data recorded in Table I demonstrate that the indexes increased upon depletion, returning toward control values after the dogs had been repleted 30 days on the whole egg proteins. The effects of depletion and repletion on UNo are illustrated also in this table. UNo is the excretion of nitrogen when the dogs are eating protein-free diet. This excretion decreased below control values upon depletion and increased toward control values upon repletion. Thus, UNo reflects the magnitude of the protein stores of the animal. Although UNo increased, it did not return to control values after thirty days of repletion on whole egg protein. These results indicate that the dogs were not completely repleted to the control state.

The total whole egg nitrogen ingested by each dog during the 30 days of repletion is recorded in Table II.

Table II

Dogs depleted in proteins were repleted for 30 days with whole egg protein. Nitrogen ingested, nitrogen excreted, and body nitrogen gained during this repletion period are recorded. Plasma protein nitrogen gained and the per cent of body nitrogen gained which is represented as plasma protein nitrogen are listed.

Dog #	Nitrogen Ingested	Nitrogen Excreted	Body Nitrogen Gained B.N.G.	Plasma Protein Nitrogen Gained P.N.G.	$\frac{\text{P.N.G.}}{\text{B.N.G.}}$ x 100
	gm/sq.M.	gm/sq.M.	gm/sq.M.	gm/sq.M.	%
28	189.0	88.6	100.5	3.06	3.02
42	174.0	81.0	93.0	2.83	3.04
44	192.0	95.8	96.2	2.84	2.98
63	176.2	83.6	92.6	4.29	4.63
74	175.1	88.2	86.9	2.11	2.43

The difference between the nitrogen ingested and nitrogen excreted is recorded as nitrogen gained in column 3. The body nitrogen gained by these dogs over the 30 day repletion period varied from 87 to 100 averaging 93.8 grams/sq.M. body surface area. The average plasma protein concentration at the end of the repletion period was 6.2 grams per cent which is the average value for most normal dogs.

The total increase in plasma protein nitrogen during the repletion period varied from 2.1 to 4.3, averaging 3 grams per sq.M. This increase in plasma protein nitrogen represented an average of 3.2 per cent of the body nitrogen gained.

A similar experiment on depletion and repletion was done on five dogs using wheat gluten instead of whole egg as a source of protein nitrogen. The data in Table III demonstrate that the nitrogen balance index of wheat gluten also increases above control values when this protein is fed to protein depleted dogs.

Table III

Nitrogen balance indexes of wheat gluten (batch #3) before and after depletion in proteins. UNo before and after depletion in proteins and after thirty days of repletion with wheat gluten.

Dog #	Nitrogen Balance Index		Protein-free urinary Nitrogen excretion (UNo)		
	Control	Depleted	Control	Depleted	Repleted
			gm/day/sq.M.	gm/day/sq.M.	gm/day/sq.M.
36	0.47	0.76	2.1	0.96	0.77
39	0.54	0.70	2.3	1.23	0.94
66	0.49	0.76	2.3	1.32	0.84
62	0.31	0.70*	2.0	1.01	0.60
60	0.42	0.57	2.10	1.24	0.78

*Estimated

The decrease in UNo due to depletion is illustrated in Table III. Repletion with wheat gluten, however, did not increase the excretion of body nitrogen as represented by UNo rather decreased it even below depletion levels. These results suggest that wheat gluten decreased rather than increased the protein stores from which catabolic nitrogen, represented by UNo, is derived. Possibly wheat gluten drew on those stores to supplement deficiences in the amino acid pattern.

A larger amount of wheat gluten was fed to 4 of these 5 dogs than was fed to the animals receiving whole egg (see Table II). This was done, hoping to obtain about the same nitrogen balance with wheat gluten as was obtained with whole egg. The data recorded in Table IV demonstrated, however, that the larger amount of wheat gluten did not result in as high values for body nitrogen gain as were obtained with the whole egg.

Table IV*

Dogs depleted in proteins were repleted for 30 days with wheat gluten. Nitrogen ingested, nitrogen excreted, and body nitrogen gained during this repletion period are recorded. Plasma protein nitrogen gained and the per cent of body nitrogen gained which is represented as plasma protein nitrogen are listed.

Dog #	Nitrogen Ingested	Nitrogen Excreted	Body Nitrogen Gained (B.N.G.)	Plasma Protein Nitrogen Gained (P.N.G.)	$\frac{\text{P.N.G.}}{\text{B.N.G.}}$ x 100
	gm/sq.M.	gm/sq.M.	gm/sq.M.	gm/sq.M.	%
36	332.6	270.3	62.3	1.5	2.2
39	351.5	273.3	78.3	2.6	3.4
66	298.2	227.3	70.9	2.4	3.3
62	136.3	103.6	32.7	1.7	5.3
60	344.0	301.6	42.4	1.1	2.6

* Some of these data appeared in Table I, report I. They are repeated here to correct figures in column 3 (nitrogen excreted) which were copied incorrectly in the previous report.

When the nitrogen intake was around 300 grams/sq.M. of body surface area the body nitrogen gain varied in 3 of the dogs between 62 and 78 grams per sq.M. When the nitrogen intake was reduced to 136 grams/sq.M. in dog 62 the body nitrogen gain was only 32.7 grams/sq.M. The plasma protein nitrogen gained in these animals average 1.9 grams/sq.M. which is less than the 3 grams obtained in the dog fed whole egg. The per cent of the body nitrogen gained, which was represented by plasma protein nitrogen, averaged 3.4 which is similar to that found in the whole egg experiments. Thus, less body nitrogen and plasma protein nitrogen were gained when feeding wheat gluten than when feeding whole egg, but the per cent of body nitrogen gained, which was represented by plasma protein nitrogen, is essentially the same whether repleting with wheat gluten or with whole egg.